Specialization	Electrical Engineering		Palestinian National Authority Ministry of Education & Higher Education Palestine Technical University College of Engineering & Technology First Exam First Semester 2011/2012
Course Name:	Power Electronics		
Date:	24/10/2011		
Time:	11:00-12:15		
Instructor:	Dr. Anees Abu Sneineh		

Name: [redacted]	Section: الإثنين - الأربعاء 12:30-2	42 /50

[redacted]

$\frac{42}{50} = \frac{21}{25}$

Q1. Choose the most correct answer: (5-marks) 4

1. To make the DIAC on, the applied voltage on its terminals must be at least:
a) 0.7V b) 0V c) Threshold voltage d) Break-over voltage

2. To make the TRIAC on, the applied voltage on its terminals must be at least:
a) 0.7V b) 0V c) Threshold voltage d) none of them

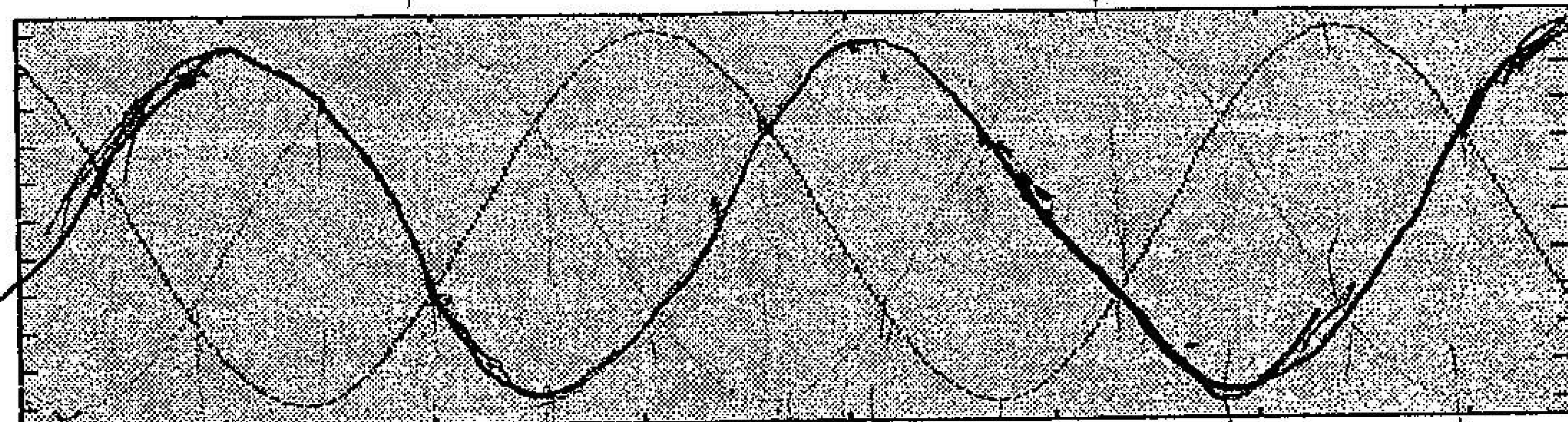
3. The minimum amount of ripple voltage occurs when using:
a) 1ϕ Half-wave Rectifier b) 3ϕ Half-wave Rectifier c) 1ϕ Bridge Rectifier d) 3ϕ Bridge Rectifier

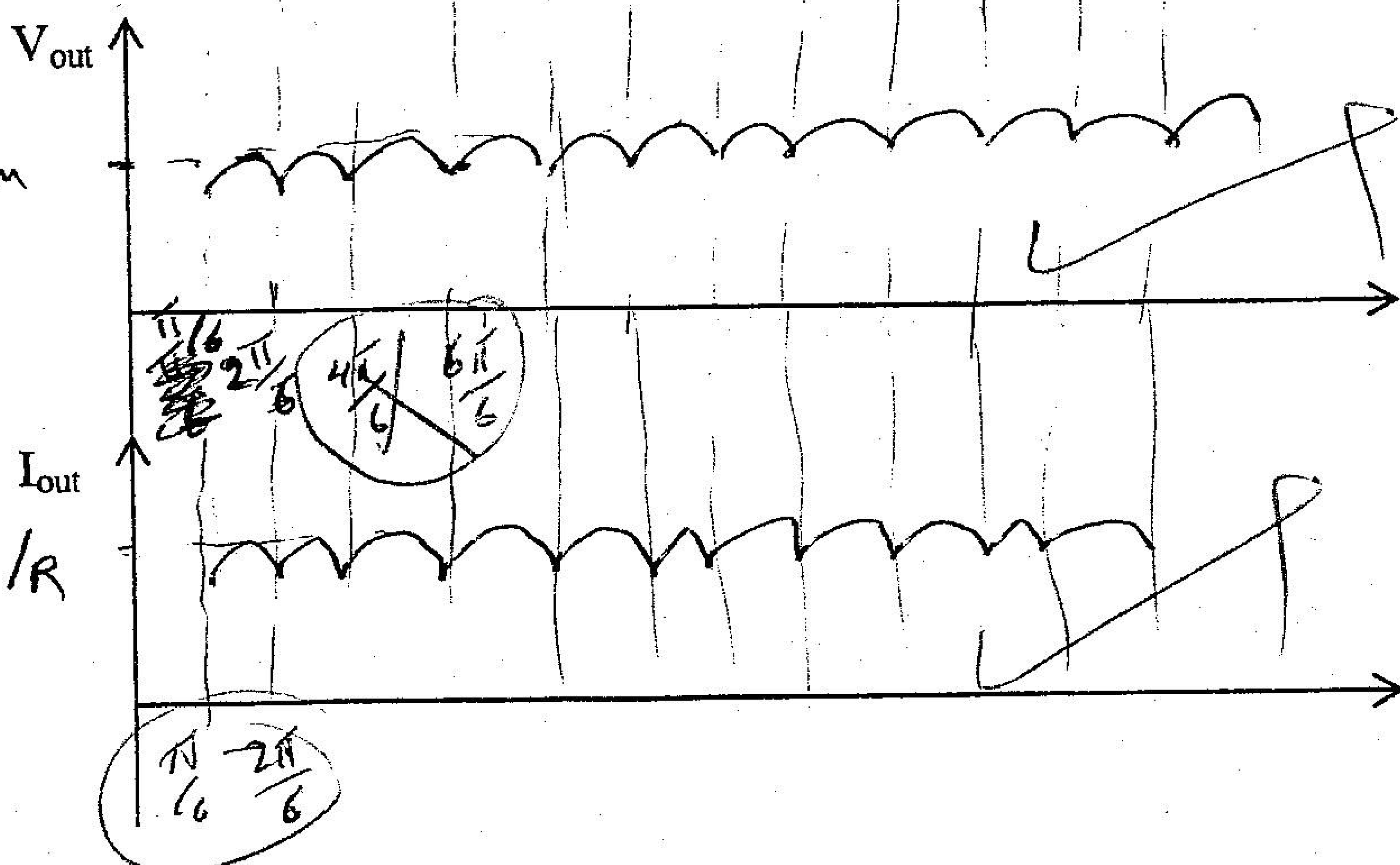
4. The Reverse Recovery Voltage occurs clearly when:
a) The ripple increased. b) The frequency is low c) the frequency is high d) none of them

5. In controlled rectifier circuits, the amount of output dc voltage increased only when:
a) DIAC voltage increased b) α increased c) α is constant d) α decreased.

Q2. For a three-phase Bridge Rectifier: (3-marks) 2

Draw the waveform of output voltage and current for R-load.





الكترونيات مقدرة الامتحان الأول

Power Electronics 1st

تم الرفع بواسطة م. معن أبو عيسى

بارك الله فيك

Q3. A single-phase Bridge rectifier has a purely resistive load of 100Ω, with a Filter capacitor of C=250μF connected to the output and the input voltage is V_s=200.*sin*(377t) V.

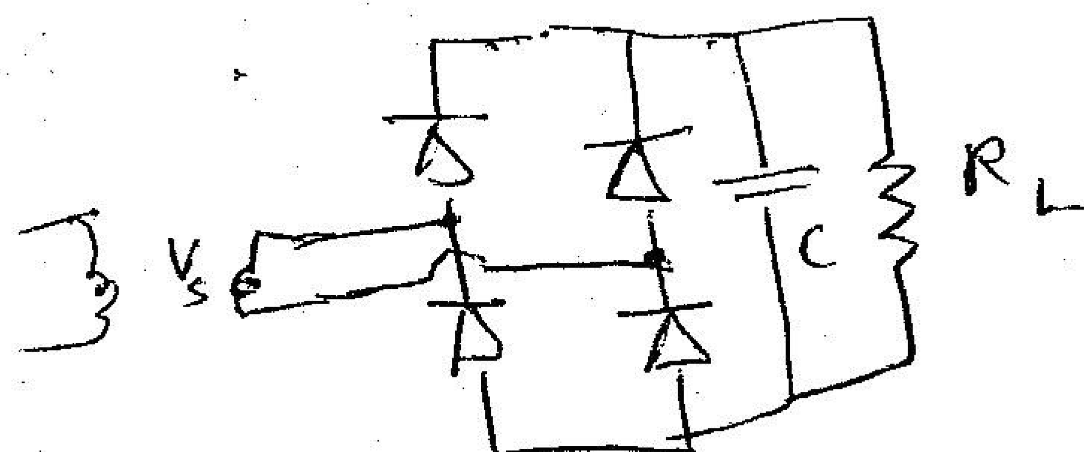
(12-marks) 12

Calculate the following output quantities: V_{ac}, V_{dc}, V_{rms}, $V_{r(p-p)}$, η, FF, RF, TUF, PIV, CF

$R_L = 100\,\Omega$

$C = 250\,\mu f$

$V_s = 200 \sin 377t$ volt



$V_{dc} = \left(1 - \frac{1}{4 f_{in} C_f R_L}\right) V_m$

$V_{r(p-p)} = \frac{V_m}{2 f_{in} R_L C_f}$

$V_{ac} = \frac{V_m}{4\sqrt{2} f_{in} R_L C_f}$

$f_{in} = \frac{377}{2\pi} = 60\ Hz$

$V_{r(p-p)} = \frac{V_m}{2 f_{in} R_L C_f} = \frac{200}{2 \times 60 \times 100 \times 250\mu}$

$V_{r(p-p)} =$ 66.67 volt

$V_{dc} = \left(1 - \frac{1}{4 \times 60 \times 250 \times 10^{-6} \times 100}\right) \times 200$

$V_{dc} =$ 166.67 volt

$V_{ac} = \frac{200}{4\sqrt{2} \times 60 \times 100 \times 250\mu} = 23.57$ volt

$V_{ac} = \sqrt{V_{rms}^2 - V_{dc}^2}$

$V_{rms} = \sqrt{V_{ac}^2 + V_{dc}^2}$

$= \sqrt{(23.52)^2 + (166.67)^2}$

$V_{rms} = 168.33$ volt

$\eta = \frac{P_{dc}}{P_{ac}} \times 100\% =$

$P_{dc} = (166.67)^2 / R = 277.79$

$P_{ac} = (168.33)^2 / R = 283.35$

$\eta = \frac{277.79}{283.35} \times 100\% = 98\%$

$FF = \frac{V_{rms}}{V_{dc}} = \frac{168.33}{166.67} = 1.01$

$= 101\%$

$RF = \sqrt{FF^2 - 1} = \sqrt{(1.01)^2 - 1}$

$= 0.142$

$= 14.2\%$

$TUF = \frac{P_{dc}}{VA\ rating} = \frac{277.79}{238.05} = 116.7\%$

$PIV = -V_m = -200$ volt

$CF = \frac{I_{s(peak)}}{I_s} = \frac{200/100}{1.6833} = 1.188$

$I_s = I_{rms} = 1.6833\ A$

$V_s = V_m/\sqrt{2} = 200/\sqrt{2} = 141.42$ V.

$VA\ rating = V_s \cdot I_s = 238.05$ watt

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Q4. **A single-phase Bridge Rectifier has RL-load. The Fourier series expression for the input current is:** $i_s(t) = \sum_{n=1,3,...}^{\infty} \frac{6I_a}{n\pi} \sin(n\omega t)$ **(5-marks)** (5)

a. If ϕ=30°, I_s=3I_a, find the Harmonic factor, the Displacement factor, and the Input Power factor.
b. If the input current's waveform improved so that I_{s1}=I_s, and θ=Φ=10°. Find the Harmonic factor, and the Input Power factor.

a) $HF = \sqrt{\left(\frac{I_s}{I_{s1}}\right)^2 - 1}$

$= \sqrt{\left(\frac{3 I_a}{6 I_a / \pi\sqrt{2}}\right)^2 - 1}$

$= \sqrt{\left(\frac{\pi\sqrt{2}}{2}\right)^2 - 1}$

$= 110.5\ \%$ ~~%~~ لين

$DF = \cos\phi = \cos 30 = 0.87$

~~DF = cos φ = 0.87~~

$PF = \frac{I_{s1}}{I_s} \cos\phi = \frac{(6 I_a/\pi\sqrt{2})}{3 I_a} \cdot DF$

$= \frac{2}{\pi\sqrt{2}} * 0.87 = 0.39$

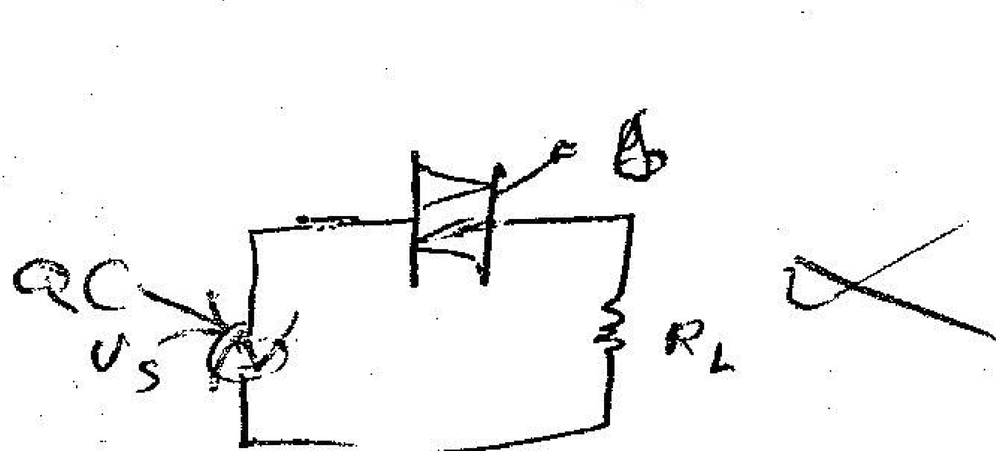
$= 39\ \%$

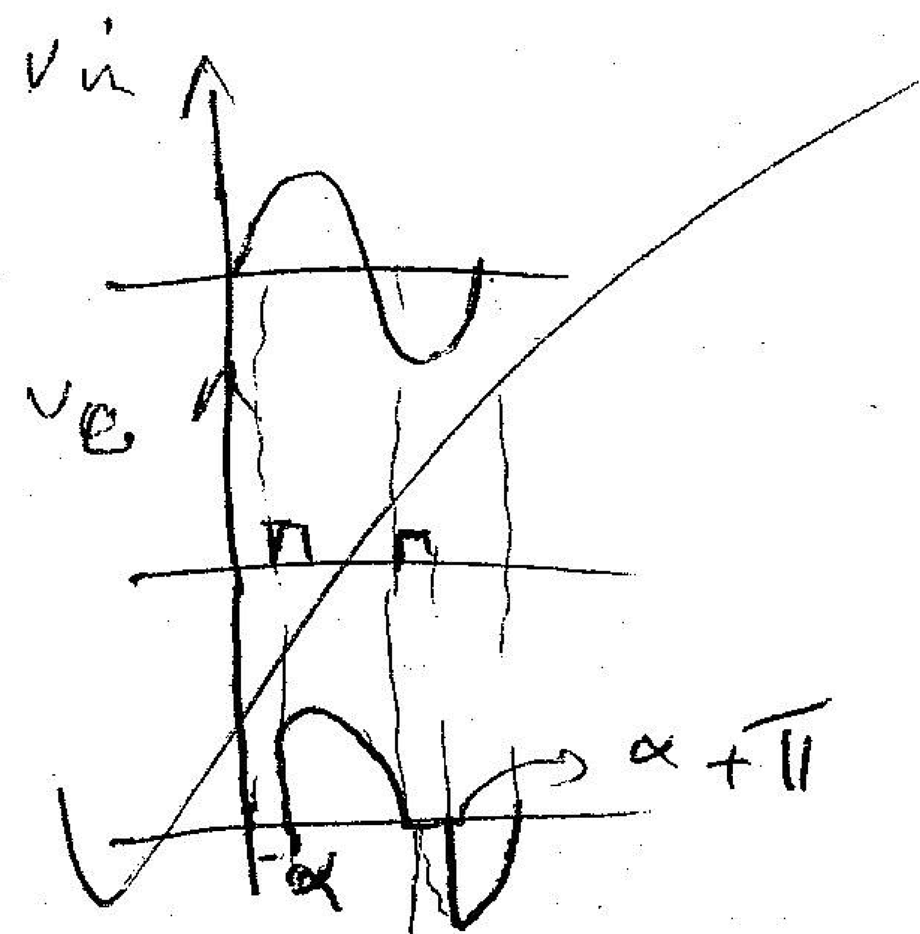
b) ~~HF~~ $I_s = I_{s1}$

$HF = Zero$

$PF = \cos\phi = \cos\theta = \cos 10 = 0.985 = 98.5\%$

Q5. **For of AC-AC Converter:** **(5-marks)** (3)
1. Draw a simple circuit.
2. Explain who this circuit operated.
3. Show its input gate and output waveforms.





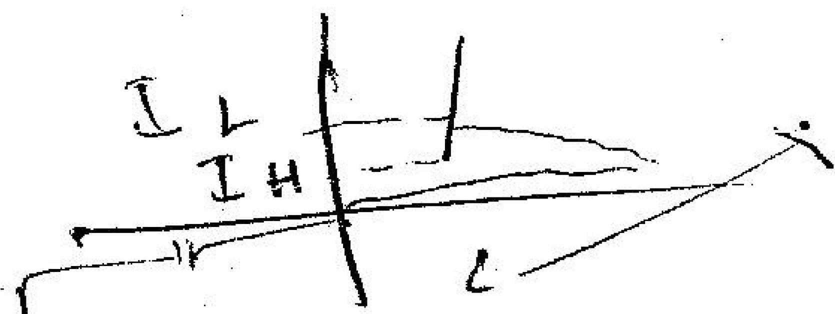
when the pulse applied on gate the positive ~~fed~~ half of wave will follow then we apply a pulse ($\alpha + \pi$) to follow the negative half of wave

Q6. For SCR switches: **(8-marks)** (5.5)

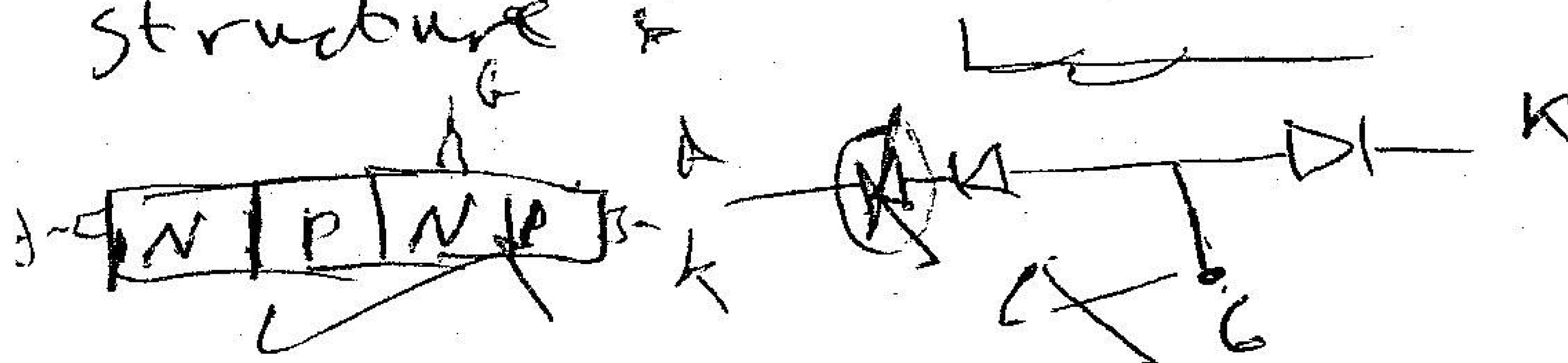
1. Draw its symbol and structure.
2. Draw the characteristic curve and show the Latching current on it.
3. Explain how this switch turned on and off in a **dc circuits**.
4. Show the input, the gate and output the waveforms for this switch in a simple **ac circuit**.

symbol :- A —▷|— K (G)

characteristic :-

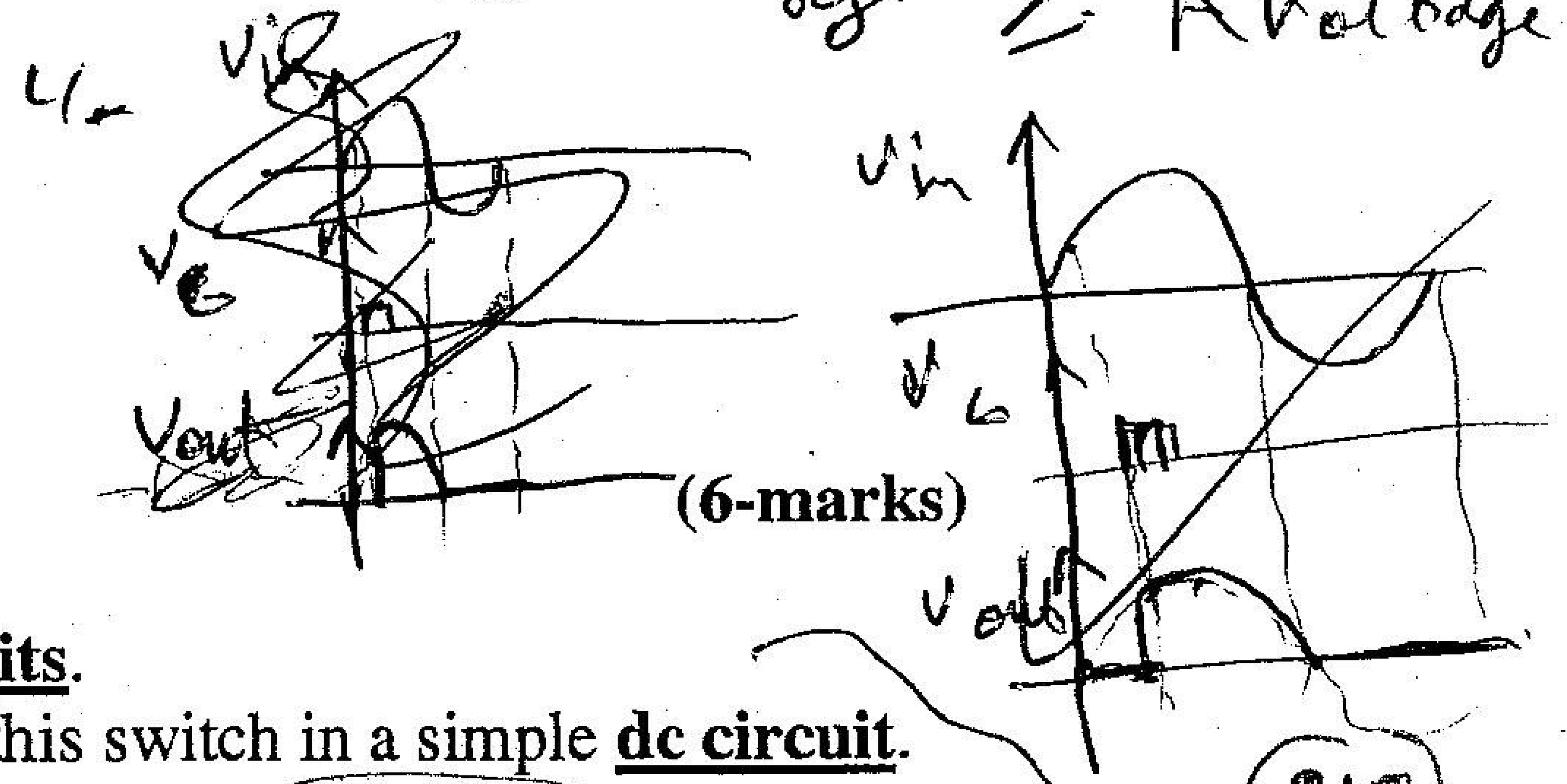


structure :-



3- the voltage applied at gate ~~to~~ (pulse) the SCR ~~be~~ turned on, to turn-off the voltage between Anode and Kathode should be zero or at negative (K voltage > A voltage).

4-



(2/8)

Q7. For IGCT switches: **(6-marks)**

1. Draw its symbol and the characteristic curve.
2. Explain how this switch turned on and off in **a dc circuits**.
3. Show the input, the gate and the output waveforms for this switch in a simple **dc circuit**.

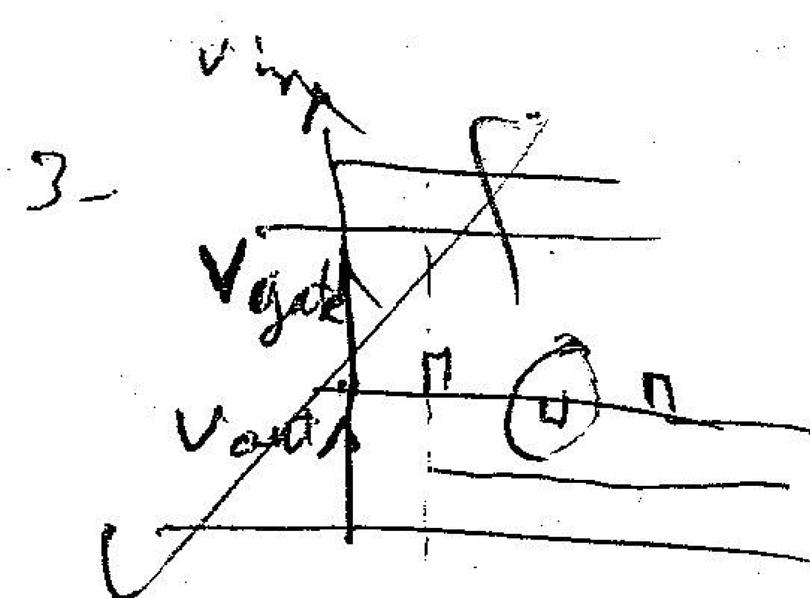
symbol :- —▷|— G

(remember its name) :

characteristic :-

when the pulse appears on gate the IGCT conduct the current but it can turned-off by one way, it is by ckt (I don't)

3-

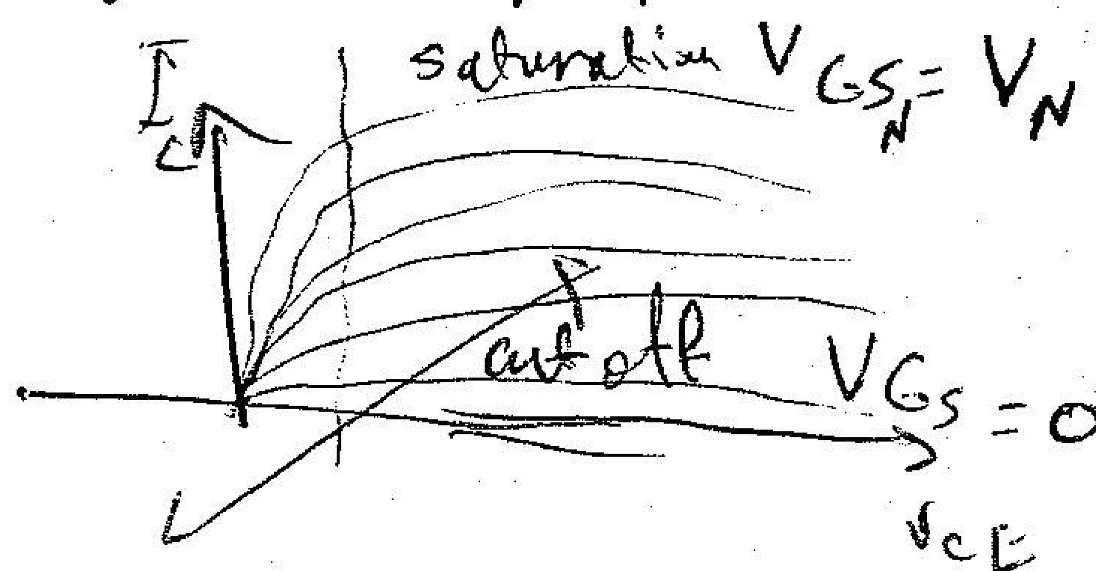


Q8. For IGBT switches: **(6-marks)** (6)

1. Draw its symbol and the characteristic curve.
2. Explain how this switch turned on and off in **a dc circuits**.
3. Show the input, the gate and the output waveforms for this switch in a simple **dc circuit**.

1 ~~A~~ symbol :- G C E

characteristic curve :-



2- when the voltage applied on V_{GE} the ~~transistor~~ become ~~at~~ saturation case so the current follow from ~~drain~~ to ~~source~~ (2 but the voltage applied zero the IGBT ~~the transistor~~ at cut off (No current) ~~as voltage~~

Best Wishes

Dr. Anees Abu Sneineh

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